Different Roles

Each of the different types of white blood cells have a special role in the immune system, and many are able to transform themselves in different ways. The following descriptions help to understand the roles of the different cells.

- **Neutrophils** are by far the most common form of white blood cells that you have in your body. Your bone marrow produces trillions of them every day and releases them into the bloodstream, but their life span is short -- generally less than a day. Once in the bloodstream neutrophils can move through capillary walls into tissue. Neutorphils are attracted to foreign material, inflammation and bacteria. If you get a splinter or a cut, neutrophils will be attracted by a process called chemotaxis. Many single-celled organisms use this same process -- chemotaxis lets motile cells move toward higher concentrations of a chemical. Once a neutrophil finds a foreign particle or a bacteria it will engulf it, releasing enzymes, hydrogen peroxide and other chemicals from its granules to kill the bacteria. In a site of serious infection (where lots of bacteria have reproduced in the area), pus will form. Pus is simply dead neutrophils and other cellular debris.
- **Eosinophils and basophils** are far less common than neutrophils. Eosinophils seem focused on parasites in the skin and the lungs, while Basophils carry histamine and therefore important (along with mast cells) to causing inflammation. From the immune system's standpoint inflammation is a good thing. It brings in more blood and it dilates capillary walls so that more immune system cells can get to the site of infection.
- Of all blood cells, **macrophages** are the biggest (hence the name "macro"). Monocytes are released by the bone marrow, float in the bloodstream, enter tissue and turn into macrophages. Most boundary tissue has its own devoted macrophages. For example, alveolar macrophages live in the lungs and keep the lungs clean (by ingesting foreign particles like smoke and dust) and disease free (by ingesting bacteria and microbes). Macrophages are called langerhans cells when they live in the skin. Macrophages also swim freely. One of their jobs is to clean up dead neutrophils -- macropghages clean up pus, for example, as part of the healing process.
- The **lymphocytes** handle most of the bacterial and viral infections that we get. Lymphocytes start in the bone marrow. Those destined to become B cells develop in the marrow before entering the bloodstream. T cells start in the marrow but

migrate through the bloodstream to the thymus and mature there. T cells and B cells are often found in the bloodstream but tend to concentrate in lymph tissue such as the lymph nodes, the thymus and the spleen. There is also quite a bit of lymph tissue in the digestive system. B cells and T cells have different functions.

- **B cells**, when stimulated, mature into plasma cells -- these are the cells that produce antibodies. A specific B cell is tuned to a specific germ, and when the germ is present in the body the B cell clones itself and produces millions of antibodies designed to eliminate the germ.
- **T cells**, on the other hand, actually bump up against cells and kill them. T cells known as Killer T cells can detect cells in your body that are harboring viruses, and when it detects such a cell it kills it. Two other types of T cells, known as Helper and Suppressor T cells, help sensitize killer T cells and control the immune response.

T Cells

Helper T cells are actually quite important and interesting. They are activated by Interleukin-1, produced by macrophages. Once activated, Helper T cells produce Interleukin-2, then interferon and other chemicals. These chemicals activate B cells so that they produce antibodies. The complexity and level of interaction between neutrophils, macrophages, T cells and B cells is really quite amazing.

Because white blood cells are so important to the immune system, they are used as a measure of immune system health. When you hear that someone has a "strong immune system" or a "suppressed immune system", one way it was determined was by counting different types of white blood cells in a blood sample. A normal white blood cell count is in the range of 4,000 to 11,000 cells per microliter of blood. 1.8 to 2.0 helper T-cells per suppressor T-cell is normal. A normal absolute neutrophil count (ANC) is in the range of 1,500 to 8,000 cells per microliter. An article like Introduction to Hematology can help you learn more about white blood cells in general and the different types of white blood cells found in your body.

One important question to ask about white blood cells (and several other parts of the immune system) is, "How does a white blood cell know what to attack and what to leave alone? Why doesn't a white blood cell attack every cell in the body?" There

is a system built into all of the cells in your body called the Major Histocompatibility Complex (MHC) (also known as the Human Leukocyte Antigen (HLA)) that marks the cells in your body as "you". Anything that the immune system finds that does not have these markings (or that has the wrong markings) is definitely "not you" and is therefore fair game. Encyclopedia Britannica has this to say about the MHC:

> *"There are two major types of MHC protein molecules--class I and class II--that span the membrane of almost every cell in an organism. In humans these molecules are encoded by several genes all clustered in the same region on chromosome 6. Each gene has an unusual number of alleles (alternate forms of a gene). As a result, it is very rare for two individuals to have the same set of MHC molecules, which are collectively called a tissue type. MHC molecules are important components of the immune response. They allow cells that have been invaded by an infectious organism to be detected by cells of the immune system called T lymphocytes, or T cells. The MHC molecules do this by presenting fragments of proteins (peptides) belonging to the invader on the surface of the cell. The T cell recognizes the foreign peptide attached to the MHC molecule and binds to it, an action that stimulates the T cell to either destroy or cure the infected cell. In uninfected healthy cells the MHC molecule presents peptides from its own cell (self peptides), to which T cells do not normally react. However, if the immune mechanism malfunctions and T cells react against self peptides, an autoimmune disease arises."*

See Biology of the Immune System and Major Histocompatibility Complex for additional details.